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Horiba et al.

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(54) **PRINTING APPARATUS**

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B41J 2/155	(2006.01)
B41J 2/14	(2006.01)
B41F 31/18	(2006.01)
B41F 31/28	(2006.01)

(Continued)

(52) **U.S. Cl.**

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(Continued)

(58) **Field of Classification Search**

CPC B41J 2/16532; B41J 2/16585; B41J 2/16523; B41J 2/1433; B41J 2/155; B41J 2/16535; B41J 2002/1694; B41P 2235/20; B41P 2235/27

See application file for complete search history.

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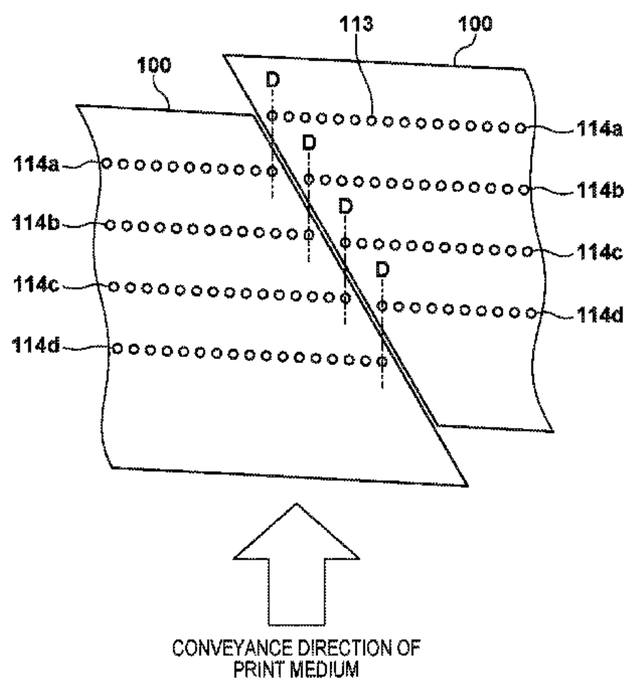
(57) **ABSTRACT**

According to an embodiment of the present invention, a printing apparatus that satisfactorily sucks and recovers a printhead is provided. A printing apparatus that includes a transfer member, and the first and second printheads has the following arrangement. The apparatus includes the first and second suction units which suck a plurality of nozzles of the first and second printheads, a common negative-pressure generation unit which generates a negative-pressure for suction by these suction units, and a moving unit which moves these suction units from one end to the other end of each printhead. Then, the moving unit moves the first and second suction units so as to pass through concave gaps with respect to ink discharge surfaces of the first and second printheads corresponding to the first and second suction units at different timings.

10 Claims, 12 Drawing Sheets



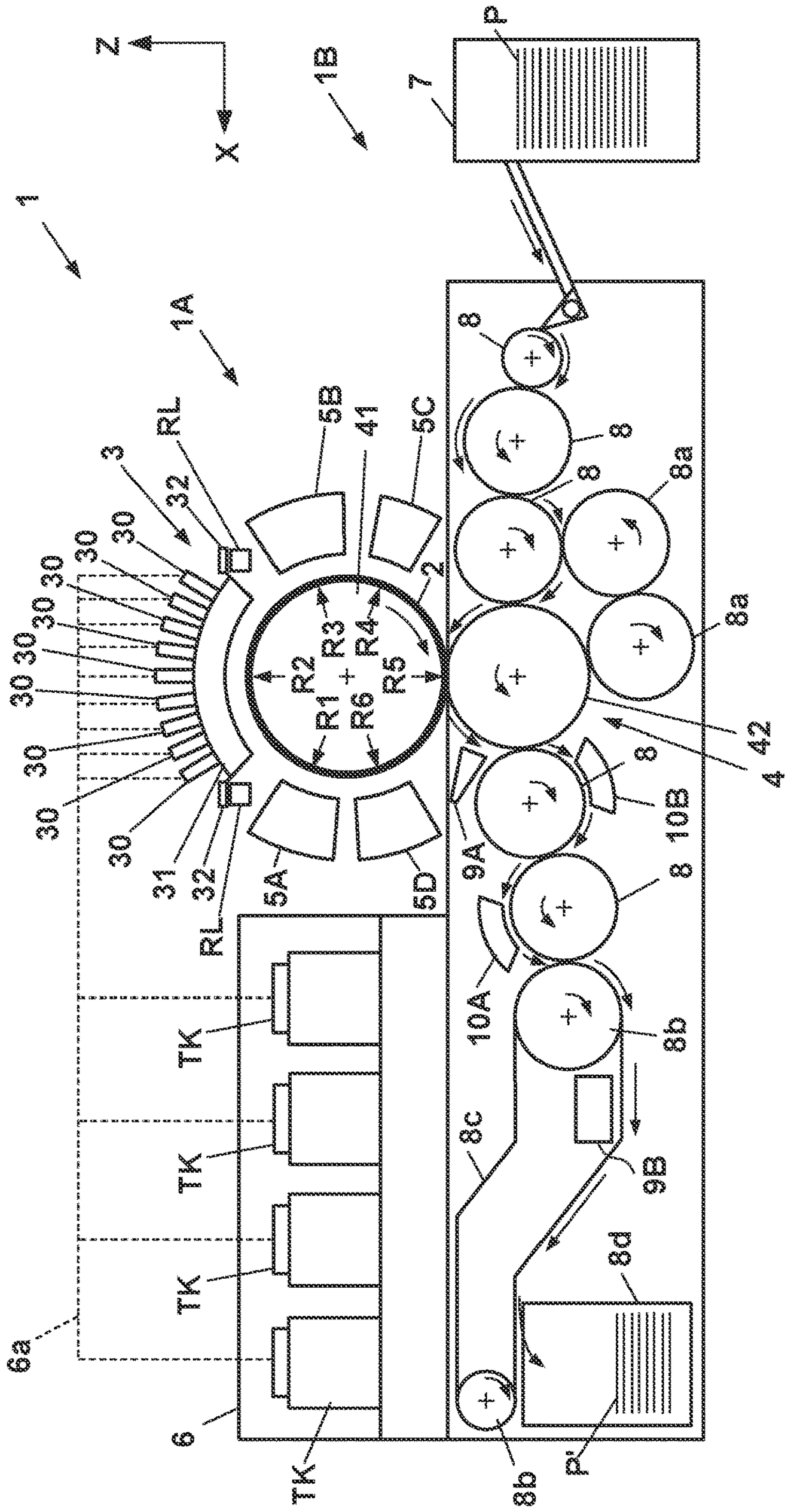
(51) **Int. Cl.**

B41F 35/02	(2006.01)
B41F 35/06	(2006.01)
B41J 2/01	(2006.01)
B41F 13/22	(2006.01)
B41J 25/00	(2006.01)

(52) **U.S. Cl.**

CPC *B41P 2235/21* (2013.01); *B41P 2235/22* (2013.01); *B41P 2235/23* (2013.01); *B41P 2235/27* (2013.01)

FIG. 1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1
1A
1B
7
P
8
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8b
8c
8d
8 10B
10A
9A
9B
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5A
5B
5C
5D
41
2
3
RL
32
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30
R1
R2
R3
R4
R5
R6
TK
6
6a
P'

FIG. 2

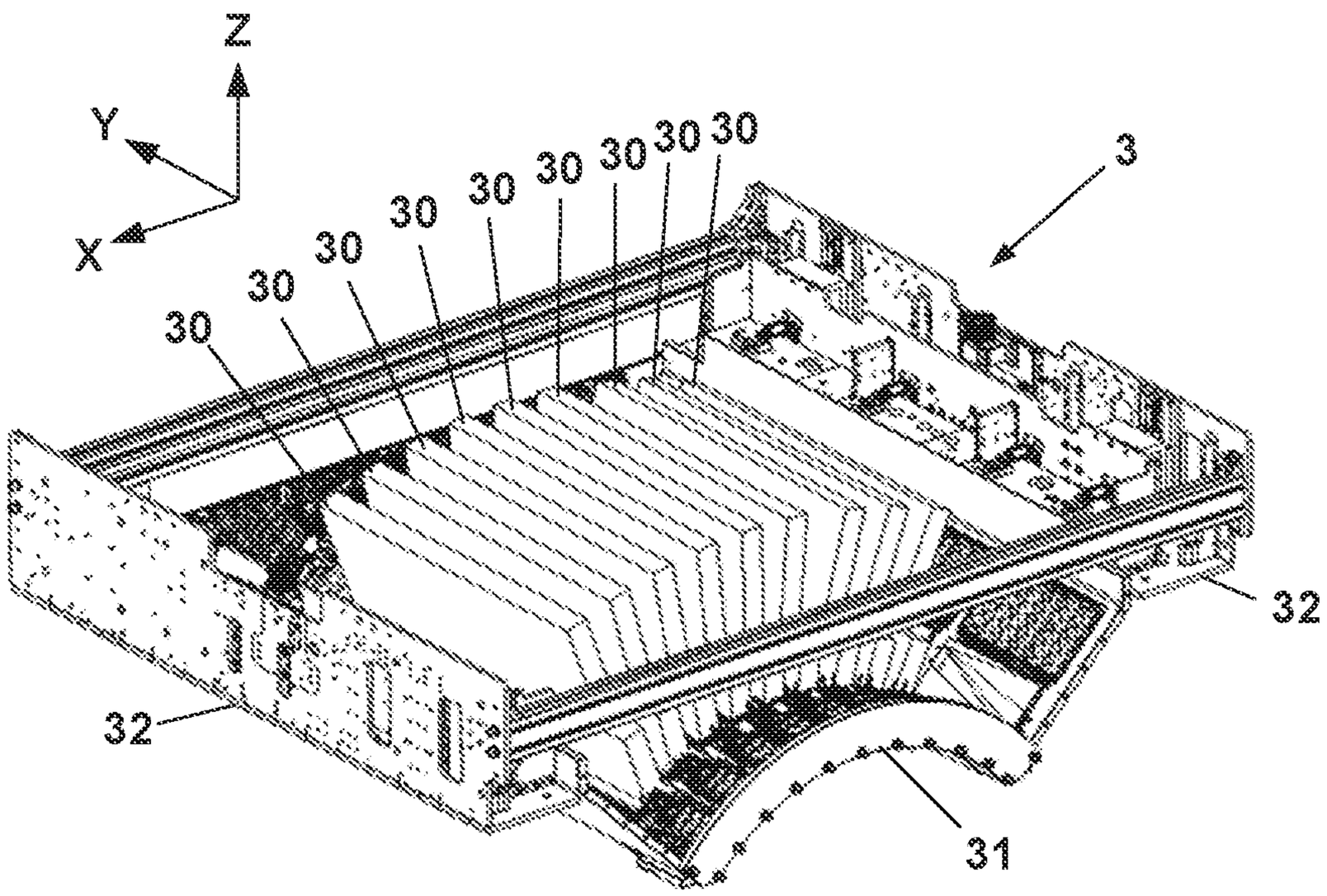


FIG. 3

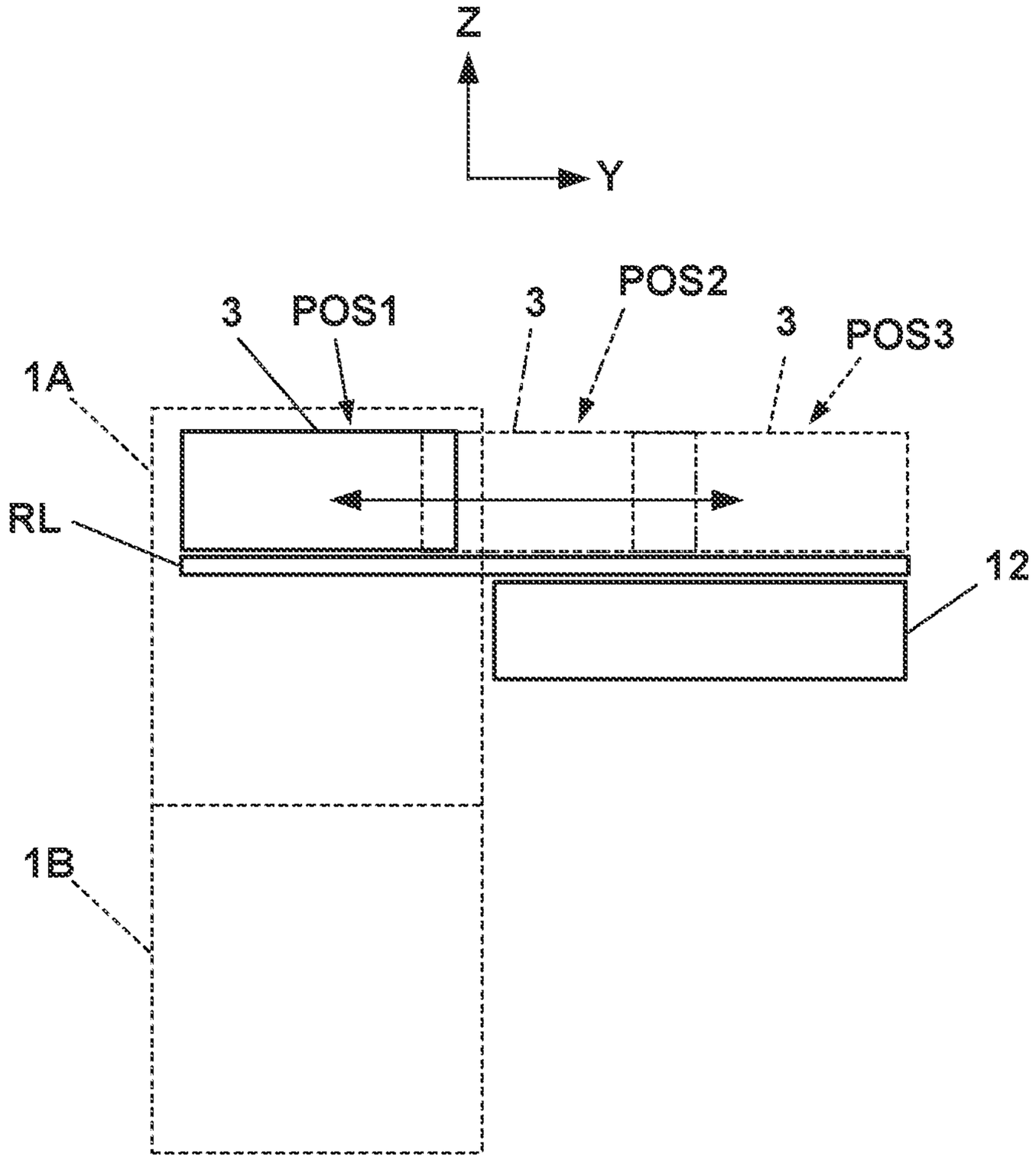
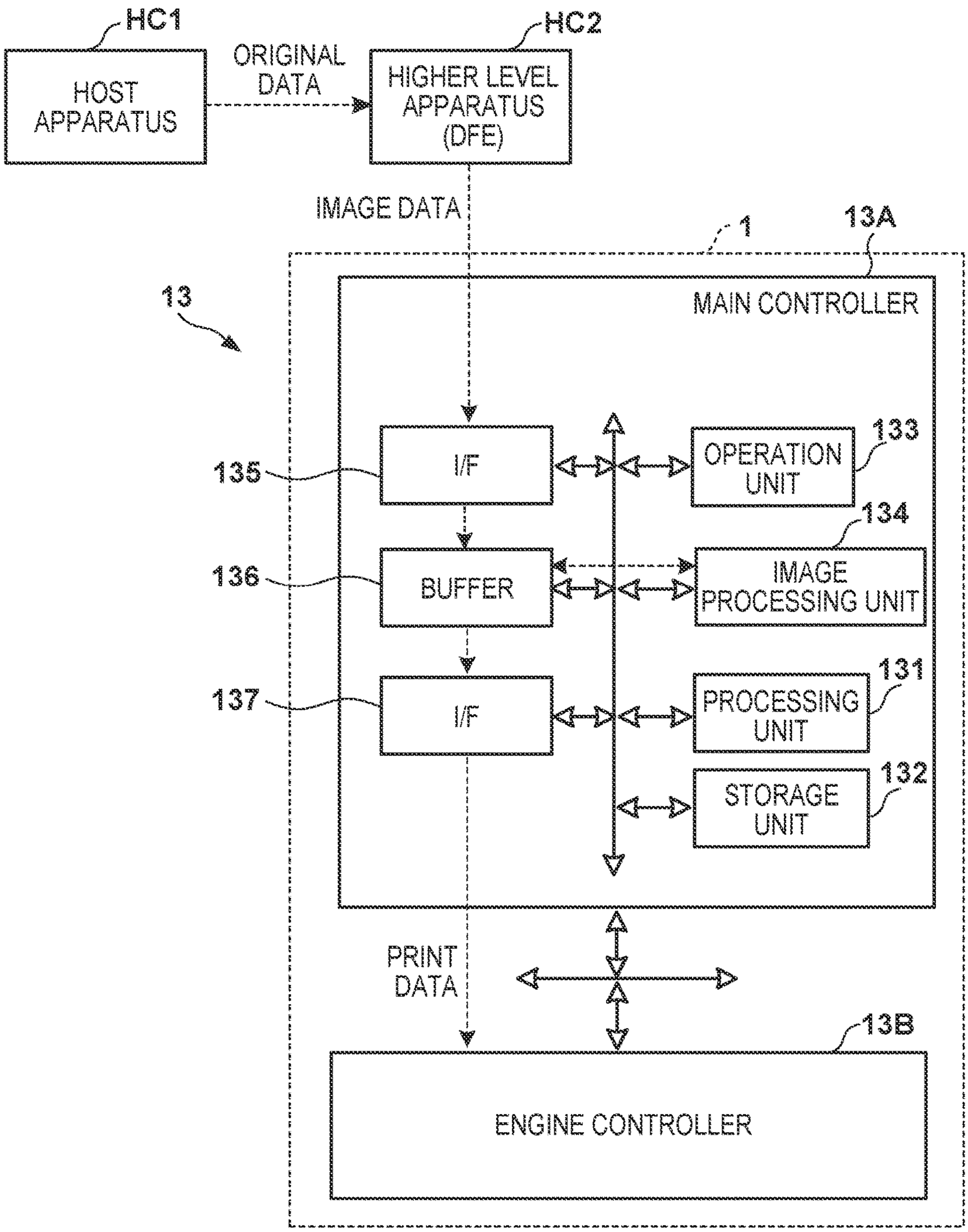


FIG. 4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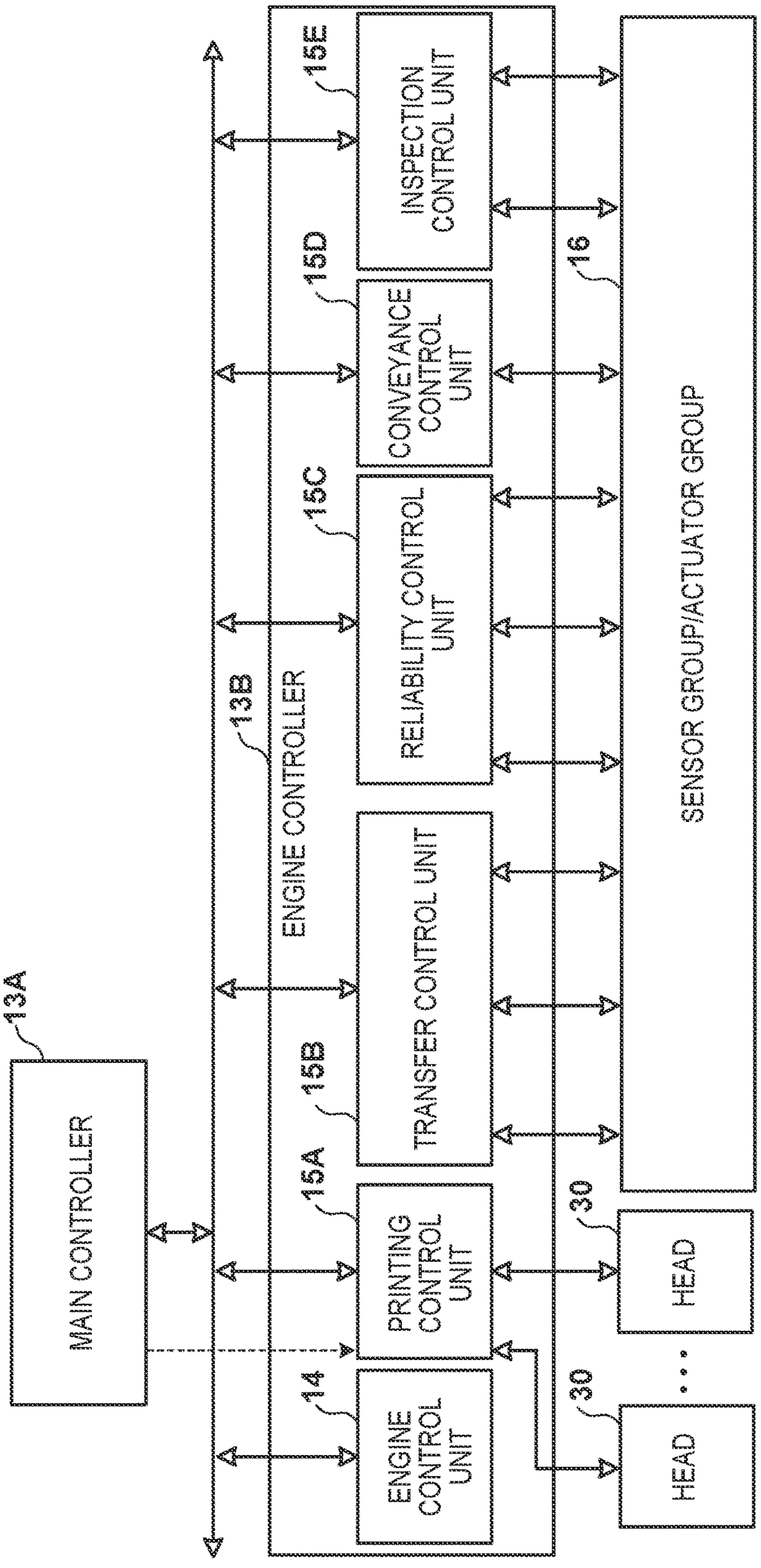
HOST APPARATUS
ORIGINAL DATA
HC2
HIGHER LEVEL APPARATUS (DFE)
IMAGE DATA
1
13A
13
MAIN CONTROLLER
135
I/F
133
OPERATION UNIT
134
136
BUFFER
IMAGE PROCESSING UNIT
137
I/F
131
PROCESSING UNIT
132
STORAGE UNIT
PRINT DATA
13B
ENGINE CONTROLLER

FIG. 5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MAIN CONTROLLER
13B
ENGINE CONTROLLER
15A
PRINTING CONTROL UNIT
15B
TRANSFER CONTROL UNIT
15C
RELIABILITY CONTROL UNIT
15D
CONVEYANCE CONTROL UNIT
15E
INSPECTION CONTROL UNIT
14
ENGINE CONTROL UNIT
16
SENSOR GROUP/ACTUATOR GROUP
30
HEAD
HEAD
30
• • •

FIG. 6

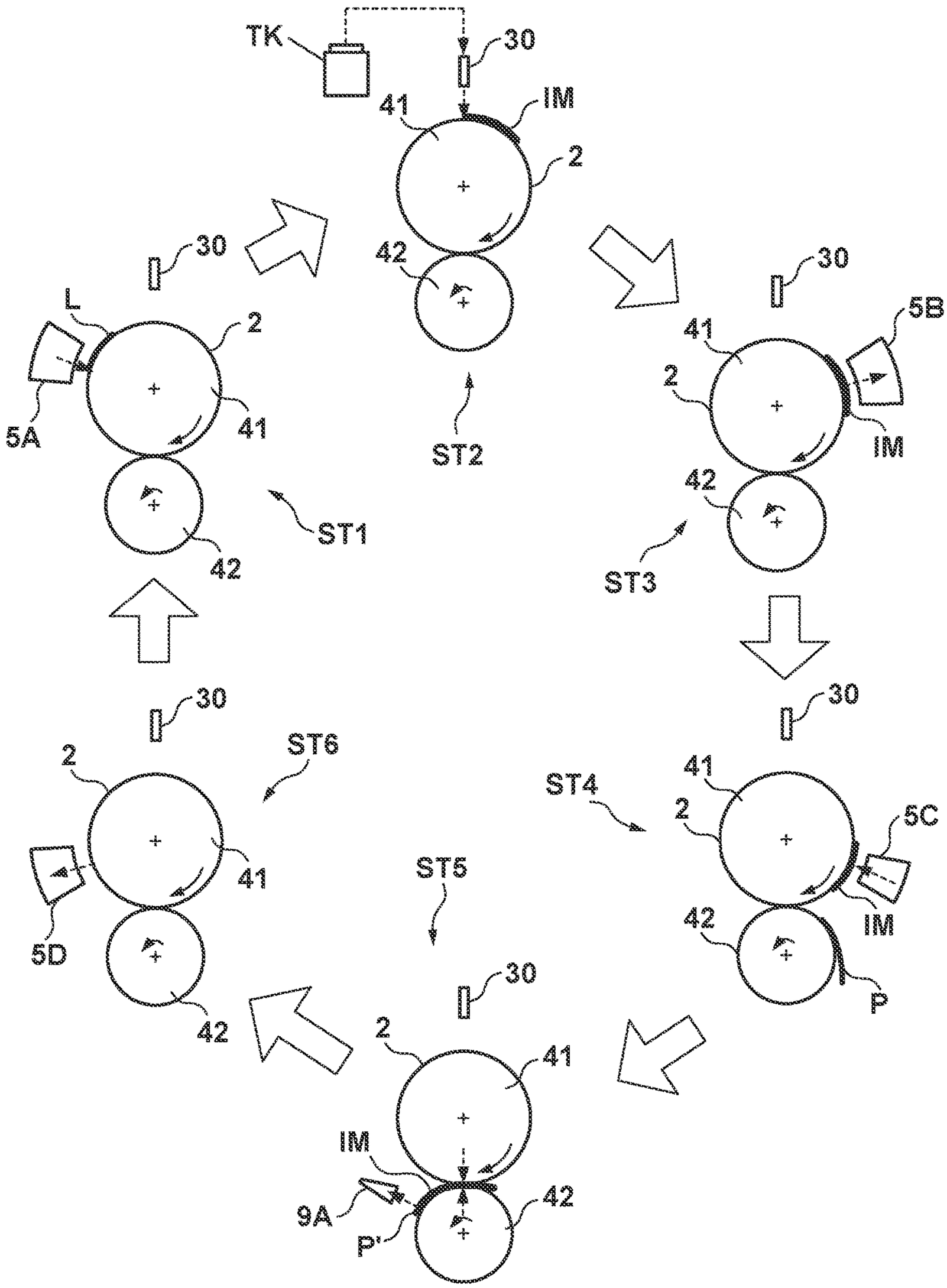


FIG. 7

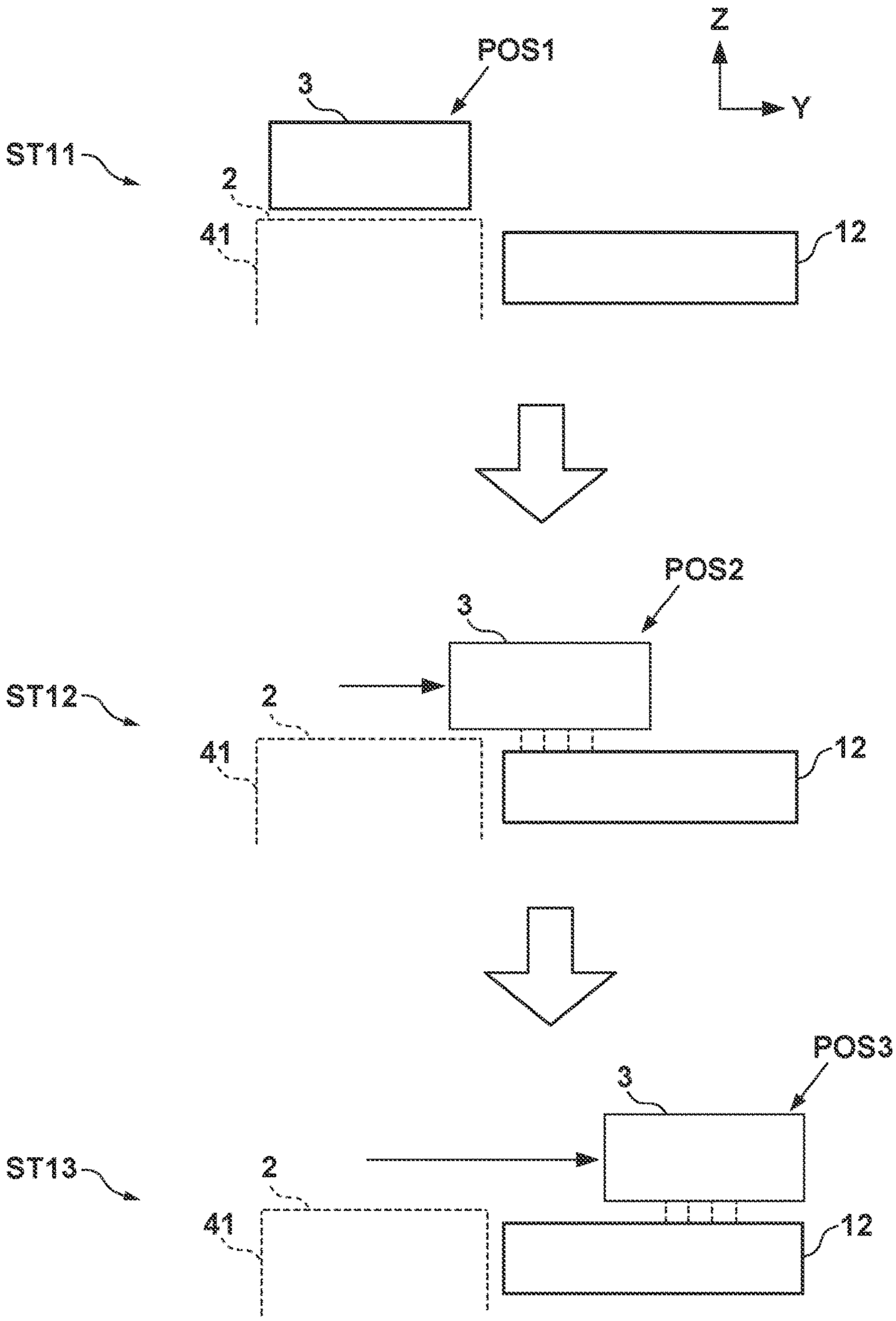
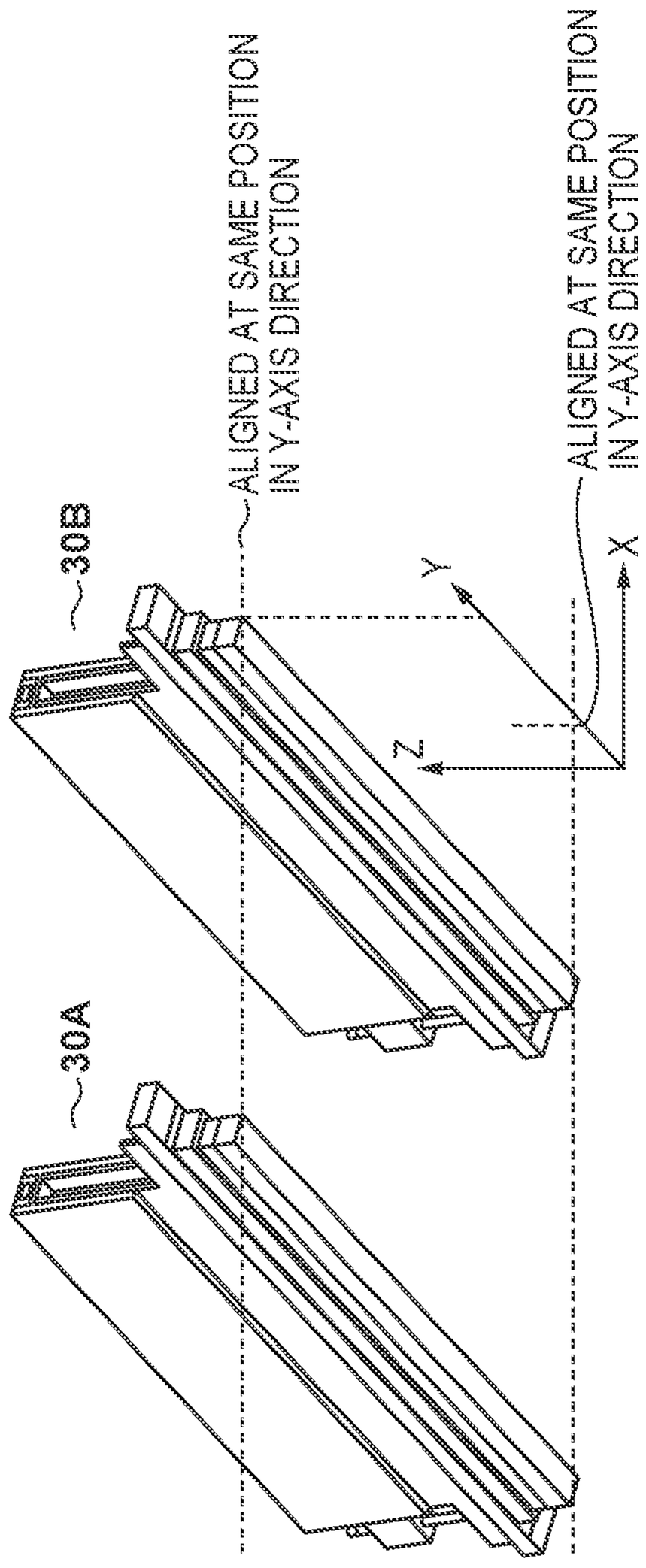


FIG. 8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IN Y-AXIS DIRECTION
30B
30A
Y
Z
X
ALIGNED AT SAME POSITION
IN Y-AXIS DIRECTION

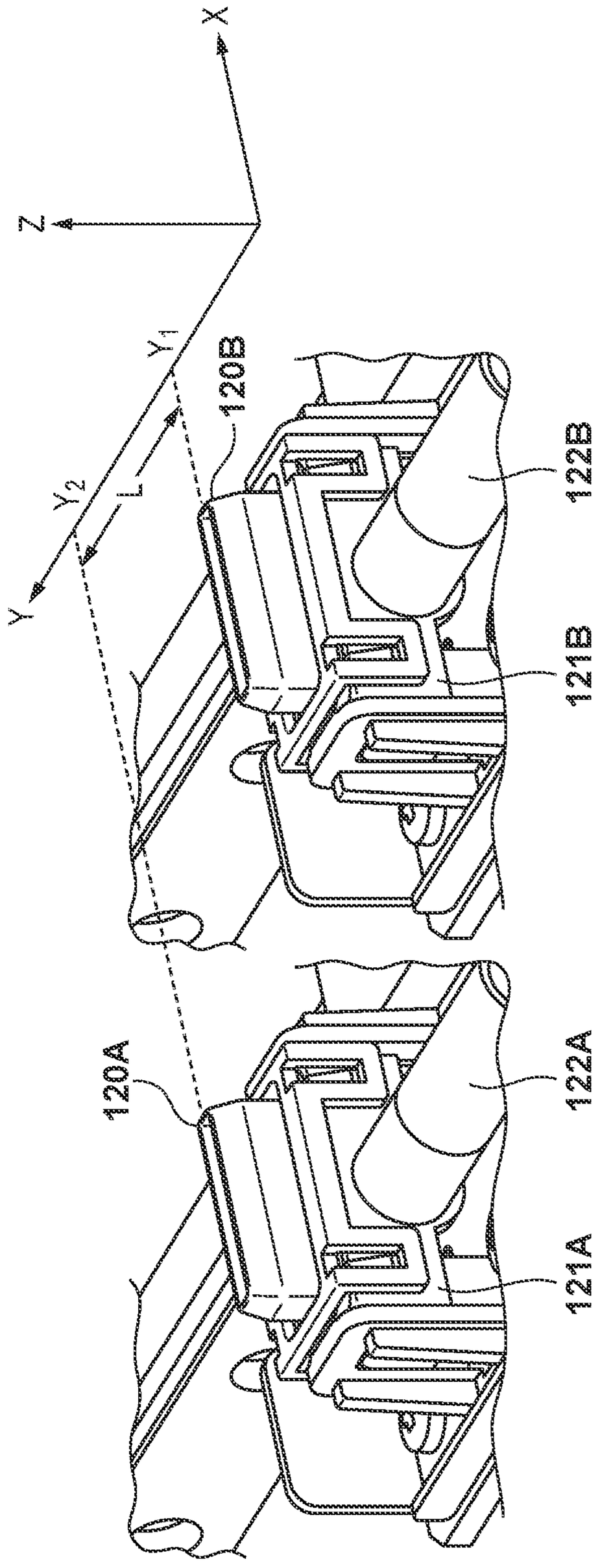


FIG. 9

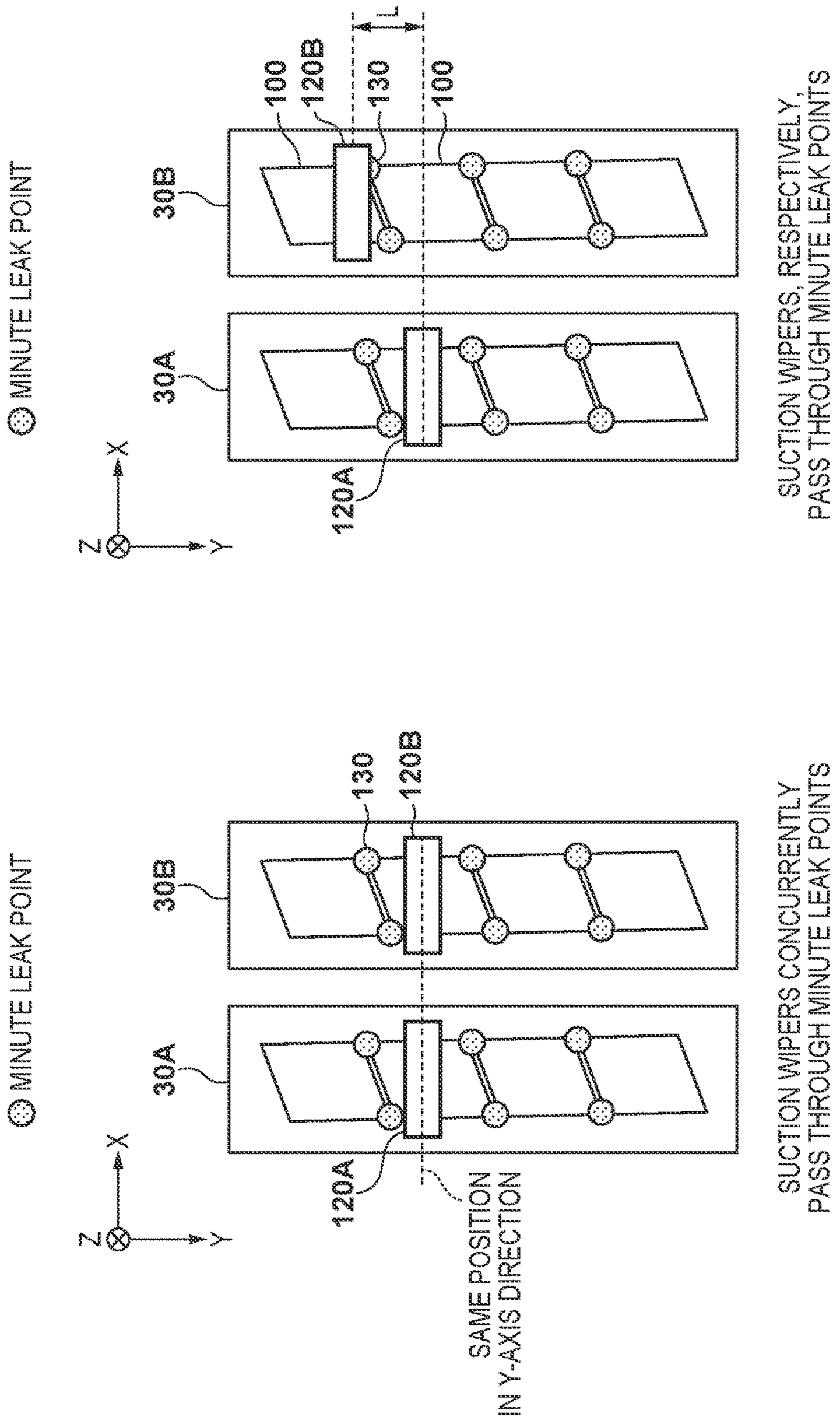


FIG. 10A

FIG. 10B

FIG. 11

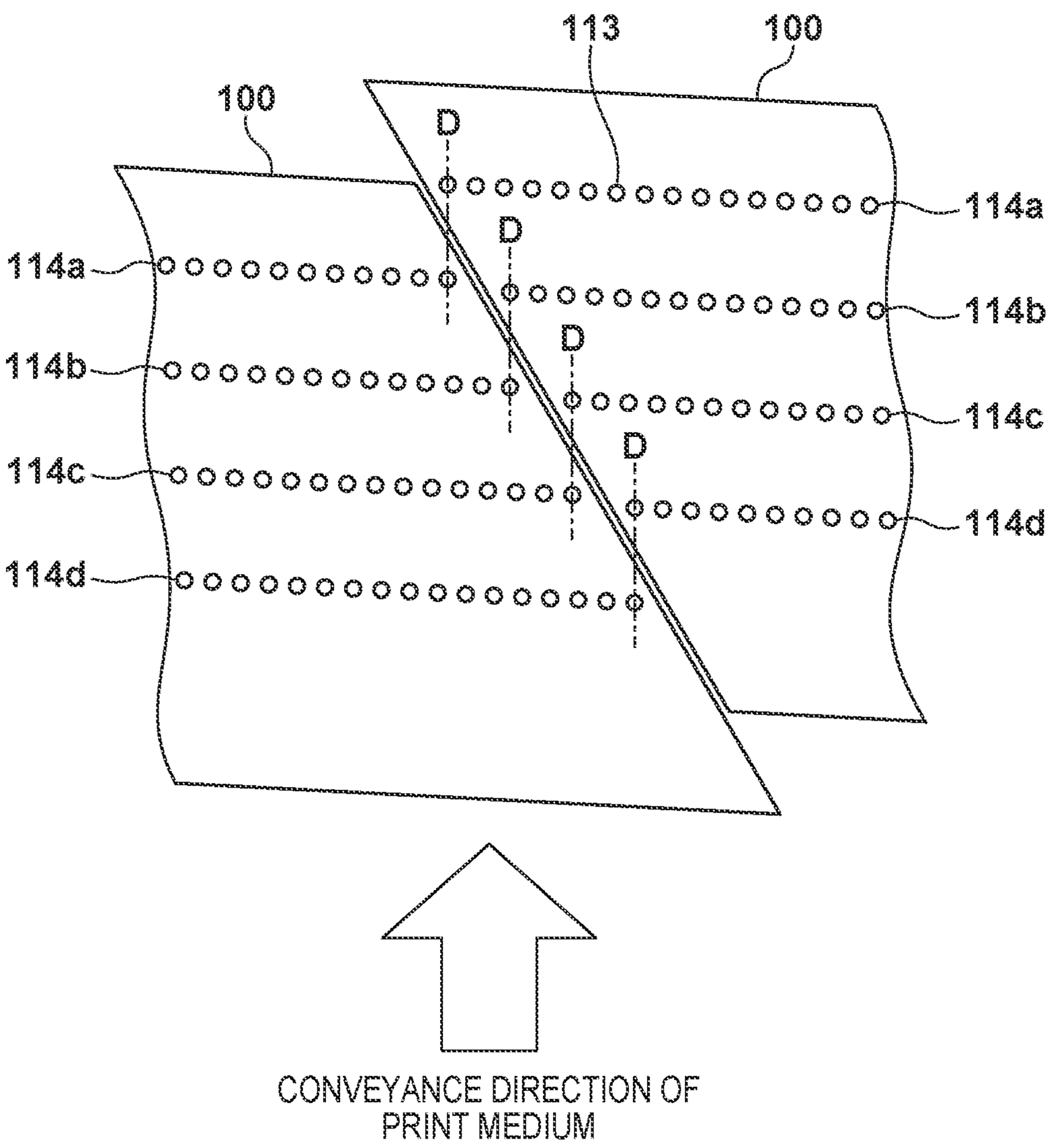
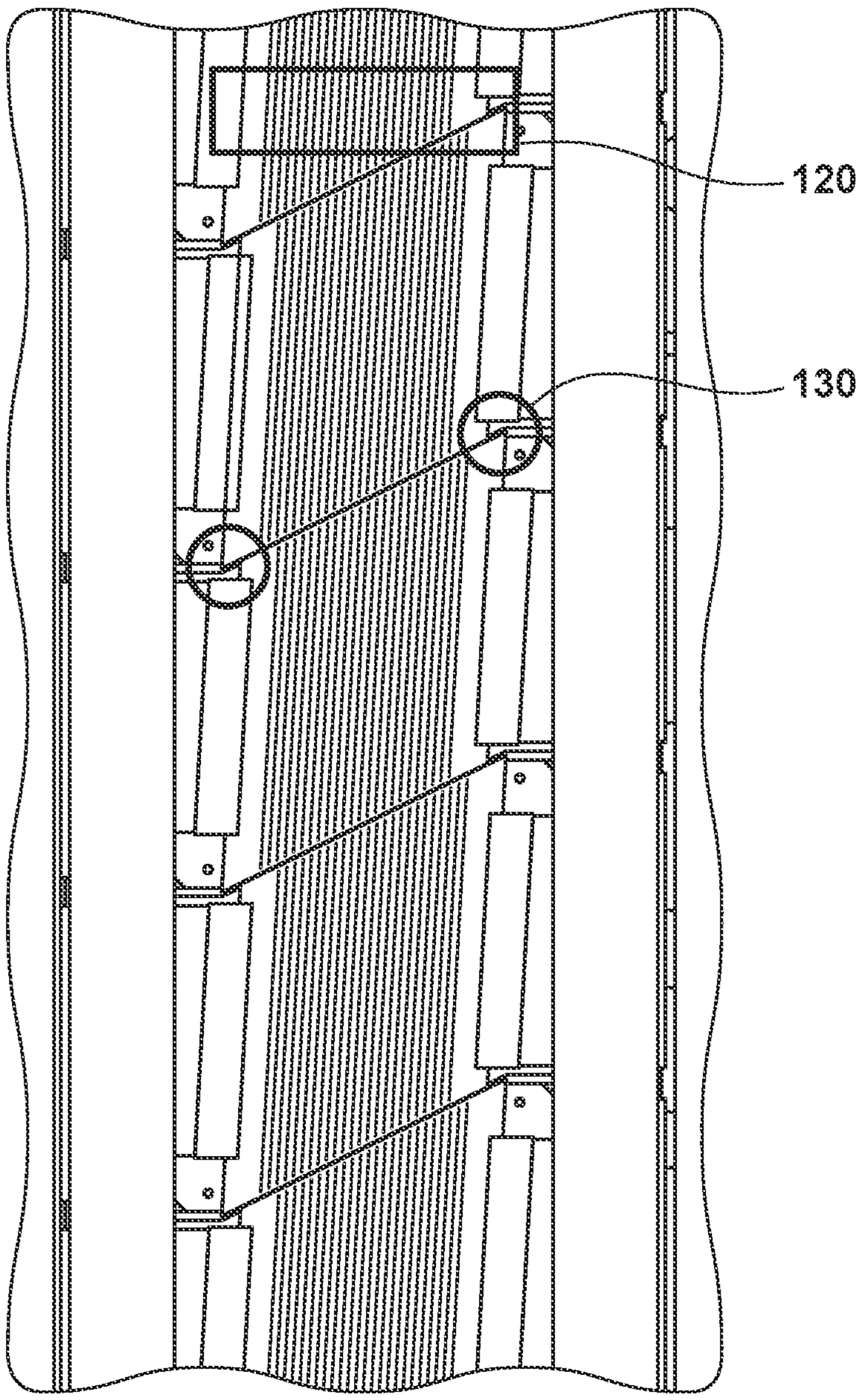

113
100
100
D
D
D
D
114a
114b
114c
114d
114a
114b
114c
114d
CONVEYANCE DIRECTION OF
PRINT MEDIUM

FIG. 12



PRINTING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a printing apparatus, and particularly to, for example, a printing apparatus that transfers an image formed by discharging ink to a transfer member to a print medium and print the image.

Description of the Related Art

Conventionally, a printing apparatus that performs printing in accordance with an inkjet method includes a recovery unit configured to maintain its printhead in a satisfactory state. The recovery unit includes, for example, a wiper that wipes an ink discharge surface (orifice surface) of the printhead while contacting the ink discharge surface, a suction port that sucks ink from a nozzle, and a suction pump that generates a negative-pressure inside the suction port. Some of such printing apparatuses use a full-line printhead configured to array head chips including a plurality of nozzles in a zigzag and correspond to the width of a print medium using a print width as a whole.

Japanese Patent Laid-Open No. 2011-104864 discloses an arrangement that cleans and recovers an ink discharge surface of a full-line printhead. More specifically, Japanese Patent Laid-Open No. 2011-104864 includes a cleaning mechanism that includes, with respect to the full-line printhead which arrays a plurality of head chips in a zigzag and forms head chip arrays of a plurality of arrays, suction ports corresponding to each of the plurality of arrays. Then, a suction recovery operation (suction operation) is performed by bringing each suction port into contact with the end portion of the head chip array, generating a negative-pressure inside the suction port, and sucking all nozzles via the suction port while moving the cleaning mechanism in an arrayed direction of the head chips.

Japanese Patent Laid-Open No. 2011-104864 also discloses an arrangement that includes two or three head chip arrays and suction ports corresponding to the arrayed position of the head chips by shifting the arrayed position in accordance with a shift. By using such an arrangement, it is possible to suck the nozzles of the two or three head chip arrays at the same timing via these suction ports when the cleaning mechanism is moved. Japanese Patent Laid-Open No. 2011-104864 also includes a common suction pump serving as a negative-pressure generation source with respect to a plurality of suction ports.

In a case where a full-line printhead having a longer print width is formed while equalizing nozzle pitches by arranging the plurality of head chips in a predetermined direction, a connection gap is formed between the head chips. In order to use all the nozzles integrated on the head chips effectively, in particular, there are head chips each having a parallelogrammic shape.

FIG. **11** is a view showing a connection gap between head chips (head substrates) each having a parallelogrammic shape.

As shown in FIG. **11**, each of two head substrates **100** includes four nozzle arrays **114***a*, **114***b*, **114***c*, and **114***d* made of a plurality of nozzles **113**. Only two head chips are shown in this view. As illustrated, however, a long print width is achieved by connecting the plurality of head substrates **100**.

In FIG. **11**, the rightmost nozzles of the nozzle arrays **114***a* to **114***d* in the left head chip and the leftmost nozzles of the nozzle arrays **114***a* to **114***d* in the right head chip overlap each other concerning a direction perpendicular to a conveyance direction of a print medium in portions indicated by alternate long and short dashed lines D. The respective nozzle arrays of the two head chips are connected in such an arrangement.

FIG. **12** is a view showing a relationship between a suction wiper and ink discharge surfaces of a plurality of connected head chips.

In FIG. **12**, a suction wiper **120** performs suction recovery while moving on the ink discharge surfaces of the plurality of head chips downward. As also indicated from FIG. **11**, gaps **130** are formed between the head chips as shown in FIG. **12**. The gaps **130** form concave portions with respect to the ink discharge surfaces.

Heaters are integrated in the plurality of nozzles formed on the head chips. When the heaters are driven in order to perform a printing operation, heat generated by the driving is conducted to the head chips. The head chips expand by the heat, and thus the gaps **130** are also needed to prevent deformation in head chips owing to the thermal expansion.

In the prior art, however, if the suction wiper performs suction while moving on the ink discharge surfaces of the plurality of connected head chips, air leaks from the gaps between the head chips, and a suction pressure drops when the suction wiper passes through the gaps because the gaps form the concave portions. In particular, when a common suction pump sucks a plurality of printheads and a plurality of head chip arrays while moving a plurality of suction ports corresponding to them, the plurality of suction ports may pass through a plurality of gaps at the same timing if they have the same head chip arrangement.

In this case, a drop in suction pressure becomes particularly large, making it impossible to perform a sufficient suction operation. As a result, the recovery operation cannot be performed on the printheads, making it impossible to perform satisfactory printing.

SUMMARY OF THE INVENTION

Accordingly, the present invention is conceived as a response to the above-described disadvantages of the conventional art.

For example, a printing apparatus according to this invention is capable of sucking and recovering a printhead satisfactorily.

According to one aspect of the present invention, there is provided a printing apparatus comprising: a print unit configured to print an image by discharging ink to an ink receiving member from a first printhead and a second printhead that are arranged in a first direction and arranged by connecting, in a second direction different from the first direction, a plurality of head substrates where a plurality of nozzles are arrayed in the second direction; a first suction unit configured to suck the plurality of nozzles of the first printhead; a second suction unit configured to suck the plurality of nozzles of the second printhead; a common negative-pressure generation unit configured to generate a negative-pressure in order to perform suction by the first suction unit and the second suction unit; and a moving unit configured to move the first suction unit and the second suction unit from one end to the other end of each of the first printhead and the second printhead in the second direction, wherein the moving unit moves the first suction unit and the second suction unit so as to pass through concave gaps with respect to ink discharge surfaces of the first printhead and the second printheads formed between the plurality of

connected head substrates arranged in the printheads corresponding to the first suction unit and the second suction unit at different timings.

The invention is particularly advantageous since it is possible to suck and recover the printhead satisfactorily.

Further features of the present invention will become apparent from the following description of exemplary embodiments (with reference to the attached drawings).

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view showing a printing system according to an exemplary embodiment of the present invention;

FIG. **2** is a perspective view showing a print unit;

FIG. **3** is an explanatory view showing a displacement mode of the print unit in FIG. **2**;

FIG. **4** is a block diagram showing a control system of the printing system in FIG. **1**;

FIG. **5** is a block diagram showing the control system of the printing system in FIG. **1**;

FIG. **6** is an explanatory view showing an example of the operation of the printing system in FIG. **1**;

FIG. **7** is an explanatory view showing an example of the operation of the printing system in FIG. **1**;

FIG. **8** is a perspective view showing an arrangement in which two printheads are provided;

FIG. **9** is a perspective view showing an arrangement in which two suction wipers are provided to the recovery unit;

FIGS. **10**A and **10**B are views each showing a suction recovery operation while two suction wipers are moving the ink discharge surfaces of the two printheads;

FIG. **11** is a view showing a connection gap between head chips each having a parallelogram shape; and

FIG. **12** is a view showing a relationship between a suction wiper and ink discharge surfaces of connected head chips.

DESCRIPTION OF THE EMBODIMENTS

Exemplary embodiments of the present invention will now be described in detail in accordance with the accompanying drawings. Note that in each drawing, arrows X and Y indicate horizontal directions perpendicular to each other, and an arrow Z indicates a up/down direction.

<Description of Terms>

In this specification, the terms "print" and "printing" not only include the formation of significant information such as characters and graphics, but also broadly includes the formation of images, figures, patterns, and the like on a print medium, or the processing of the medium, regardless of whether they are significant or insignificant and whether they are so visualized as to be visually perceivable by humans.

Also, the term "print medium (or sheet)" not only includes a paper sheet used in common printing apparatuses, but also broadly includes materials, such as cloth, a plastic film, a metal plate, glass, ceramics, wood, and leather, capable of accepting ink.

Furthermore, the term "ink" (to be also referred to as a "liquid" hereinafter) should be broadly interpreted to be similar to the definition of "print" described above. That is, "ink" includes a liquid which, when applied onto a print medium, can form images, figures, patterns, and the like, can process the print medium, and can process ink. The process of ink includes, for example, solidifying or insolubilizing a coloring agent contained in ink applied to the print medium. Note that this invention is not limited to any specific ink component, however, it is assumed that this embodiment uses water-base ink including water, resin, and pigment serving as coloring material.

Further, a "print element (or nozzle)" generically means an ink orifice or a liquid channel communicating with it, and an element for generating energy used to discharge ink, unless otherwise specified.

An element substrate for a printhead (head substrate) used below means not merely a base made of a silicon semiconductor, but an arrangement in which elements, wirings, and the like are arranged.

Further, "on the substrate" means not merely "on an element substrate", but even "the surface of the element substrate" and "inside the element substrate near the surface". In the present invention, "built-in" means not merely arranging respective elements as separate members on the base surface, but integrally forming and manufacturing respective elements on an element substrate by a semiconductor circuit manufacturing process or the like.

<Printing System>

FIG. **1** is a front view schematically showing a printing system **1** according to an embodiment of the present invention. The printing system **1** is a sheet inkjet printer that forms a printed product P' by transferring an ink image to a print medium P via a transfer member **2**. The printing system **1** includes a printing apparatus **1**A and a conveyance apparatus **1**B. In this embodiment, an X direction, a Y direction, and a Z direction indicate the widthwise direction (total length direction), the depth direction, and the height direction of the printing system **1**, respectively. The print medium P is conveyed in the X direction.

<Printing Apparatus>

The printing apparatus **1**A includes a print unit **3**, a transfer unit **4**, peripheral units **5**A to **5**D, and a supply unit **6**.

<Print Unit>

The print unit **3** includes a plurality of printheads **30** and a carriage **31**. A description will be made with reference to FIGS. **1** and **2**. FIG. **2** is perspective view showing the print unit **3**. The printheads **30** discharge liquid ink to the transfer member (intermediate transfer member) **2** and form ink images of a printed image on the transfer member **2**.

In this embodiment, each printhead **30** is a full-line head elongated in the Y direction, and nozzles are arrayed in a range where they cover the width of an image printing area of a print medium having a usable maximum size. Each printhead **30** has an ink discharge surface with the opened nozzle on its lower surface, and the ink discharge surface faces the surface of the transfer member **2** via a minute gap (for example, several mm). In this embodiment, the transfer member **2** is configured to move on a circular orbit cyclically, and thus the plurality of printheads **30** are arranged radially.

Each nozzle includes a discharge element. The discharge element is, for example, an element that generates a pressure in the nozzle and discharges ink in the nozzle, and the technique of an inkjet head in a well-known inkjet printer is applicable. For example, an element that discharges ink by causing film boiling in ink with an electrothermal transducer and forming a bubble, an element that discharges ink by an electromechanical transducer (piezoelectric element), an element that discharges ink by using static electricity, or the like can be given as the discharge element. A discharge element that uses the electrothermal transducer can be used from the viewpoint of high-speed and high-density printing.

In this embodiment, nine printheads **30** are provided. The respective printheads **30** discharge different kinds of inks. The different kinds of inks are, for example, different in coloring material and include yellow ink, magenta ink, cyan ink, black ink, and the like. One printhead **30** discharges one kind of ink. However, one printhead **30** may be configured to discharge the plurality of kinds of inks. When the plurality of printheads **30** are thus provided, some of them may discharge ink (for example, clear ink) that does not include a coloring material.

The carriage **31** supports the plurality of printheads **30**. The end of each printhead **30** on the side of an ink discharge surface is fixed to the carriage **31**. This makes it possible to maintain a gap on the surface between the ink discharge surface and the transfer member **2** more precisely. The carriage **31** is configured to be displaceable while mounting the printheads **30** by the guide of each guide member RL. In this embodiment, the guide members RL are rail members elongated in the Y direction and provided as a pair separately in the X direction. A slide portion **32** is provided on each side of the carriage **31** in the X direction. The slide portions **32** engage with the guide members RL and slide along the guide members RL in the Y direction.

FIG. **3** is a view showing a displacement mode of the print unit **3** and schematically shows the right side surface of the printing system **1**. A recovery unit **12** is provided in the rear of the printing system **1**. The recovery unit **12** has a mechanism for recovering discharge performance of the printheads **30**. For example, a cap mechanism which caps the ink discharge surface of each printhead **30**, a wiper mechanism which wipes the ink discharge surface, a suction mechanism which sucks ink in the printhead **30** by a negative pressure from the ink discharge surface can be given as such mechanisms.

The guide member RL is elongated over the recovery unit **12** from the side of the transfer member **2**. By the guide of the guide member RL, the print unit **3** is displaceable between a discharge position POS**1** at which the print unit **3** is indicated by a solid line and a recovery position POS**3** at which the print unit **3** is indicated by a broken line, and is moved by a driving mechanism (not shown).

The discharge position POS**1** is a position at which the print unit **3** discharges ink to the transfer member **2** and a position at which the ink discharge surface of each printhead **30** faces the surface of the transfer member **2**. The recovery position POS**3** is a position retracted from the discharge position POS**1** and a position at which the print unit **3** is positioned above the recovery unit **12**. The recovery unit **12** can perform recovery processing on the printheads **30** when the print unit **3** is positioned at the recovery position POS**3**. In this embodiment, the recovery unit **12** can also perform the recovery processing in the middle of movement before the print unit **3** reaches the recovery position POS**3**. There is a preliminary recovery position POS**2** between the discharge position POS**1** and the recovery position POS**3**. The recovery unit **12** can perform preliminary recovery processing on the printheads **30** at the preliminary recovery position POS**2** while the printheads **30** move from the discharge position POS**1** to the recovery position POS**3**.

<Transfer Unit>

The transfer unit **4** will be described with reference to FIG. **1**. The transfer unit **4** includes a transfer drum **41** and a pressurizing drum **42**. Each of these drums is a rotating body that rotates about a rotation axis in the Y direction and has a columnar outer peripheral surface. In FIG. **1**, arrows shown in respective views of the transfer drum **41** and the pressurizing drum **42** indicate their rotation directions. The transfer drum **41** rotates clockwise, and the pressurizing drum **42** rotates anticlockwise.

The transfer drum **41** is a support member that supports the transfer member **2** on its outer peripheral surface. The transfer member **2** is provided on the outer peripheral surface of the transfer drum **41** continuously or intermittently in a circumferential direction. If the transfer member **2** is provided continuously, it is formed into an endless swath. If the transfer member **2** is provided intermittently, it is formed into swaths with ends dividedly into a plurality of segments. The respective segments can be arranged in an arc at an equal pitch on the outer peripheral surface of the transfer drum **41**.

The transfer member **2** moves cyclically on the circular orbit by rotating the transfer drum **41**. By the rotational phase of the transfer drum **41**, the position of the transfer member **2** can be discriminated into a processing area R**1** before discharge, a discharge area R**2**, processing areas R**3** and R**4** after discharge, a transfer area R**5**, and a processing area R**6** after transfer. The transfer member **2** passes through these areas cyclically.

The processing area R**1** before discharge is an area where preprocessing is performed on the transfer member **2** before the print unit **3** discharges ink and an area where the peripheral unit **5**A performs processing. In this embodiment, a reactive liquid is applied. The discharge area R**2** is a formation area where the print unit **3** forms an ink image by discharging ink to the transfer member **2**. The processing areas R**3** and R**4** after discharge are processing areas where processing is performed on the ink image after ink discharge. The processing area R**3** after discharge is an area where the peripheral unit **5**B performs processing, and the processing area R**4** after discharge is an area where the peripheral unit **5**C performs processing. The transfer area R**5** is an area where the transfer unit **4** transfers the ink image on the transfer member **2** to the print medium P. The processing area R**6** after transfer is an area where post processing is performed on the transfer member **2** after transfer and an area where the peripheral unit **5**D performs processing.

In this embodiment, the discharge area R**2** is an area with a predetermined section. The other areas R**1** and R**3** to R**6** have narrower sections than the discharge area R**2**. Comparing to the face of a clock, in this embodiment, the processing area R**1** before discharge is positioned at almost 10 o'clock, the discharge area R**2** is in a range from almost 11 o'clock to 1 o'clock, the processing area R**3** after discharge is positioned at almost 2 o'clock, and the processing area R**4** after discharge is positioned at almost 4 o'clock. The transfer area R**5** is positioned at almost 6 o'clock, and the processing area R**6** after transfer is an area at almost 8 o'clock.

The transfer member **2** may be formed by a single layer but may be an accumulative body of a plurality of layers. If the transfer member **2** is formed by the plurality of layers, it may include three layers of, for example, a surface layer, an elastic layer, and a compressed layer. The surface layer is an outermost layer having an image formation surface where the ink image is formed. By providing the compressed layer, the compressed layer absorbs deformation and disperses a local pressure fluctuation, making it possible to maintain transferability even at the time of high-speed printing. The elastic layer is a layer between the surface layer and the compressed layer.

As a material for the surface layer, various materials such as a resin and a ceramic can be used appropriately. In respect of durability or the like, however, a material high in com-

pressive modulus can be used. More specifically, an acrylic resin, an acrylic silicone resin, a fluoride-containing resin, a condensate obtained by condensing a hydrolyzable organosilicon compound, and the like can be given. The surface layer that has undergone a surface treatment may be used in order to improve wettability of the reactive liquid, the transferability of an image, or the like. Frame processing, a corona treatment, a plasma treatment, a polishing treatment, a roughing treatment, an active energy beam irradiation treatment, an ozone treatment, a surfactant treatment, a silane coupling treatment, or the like can be given as the surface treatment. A plurality of them may be combined. It is also possible to provide any desired surface shape in the surface layer.

For example, acrylonitrile-butadiene rubber, acrylic rubber, chloroprene rubber, urethane rubber, silicone rubber, or the like can be given as a material for the compressed layer. When such a rubber material is formed, a porous rubber material may be formed by blending a predetermined amount of a vulcanizing agent, vulcanizing accelerator, or the like and further blending a foaming agent, or a filling agent such as hollow fine particles or salt as needed. Consequently, a bubble portion is compressed along with a volume change with respect to various pressure fluctuations, and thus deformation in directions other than a compression direction is small, making it possible to obtain more stable transferability and durability. As the porous rubber material, there are a material having an open cell structure in which respective pores continue to each other and a material having a closed cell structure in which the respective pores are independent of each other. However, either structure may be used, or both of these structures may be used.

As a member for the elastic layer, the various materials such as the resin and the ceramic can be used appropriately. In respect of processing characteristics, various materials of an elastomer material and a rubber material can be used. More specifically, for example, fluorosilicone rubber, phenyl silicone rubber, fluorine rubber, chloroprene rubber, urethane rubber, nitrile rubber, and the like can be given. In addition, ethylene propylene rubber, natural rubber, styrene rubber, isoprene rubber, butadiene rubber, the copolymer of ethylene/propylene/butadiene, nitrile-butadiene rubber, and the like can be given. In particular, silicone rubber, fluorosilicone rubber, and phenyl silicon rubber are advantageous in terms of dimensional stability and durability because of their small compression set. They are also advantageous in terms of transferability because of their small elasticity change by a temperature.

Between the surface layer and the elastic layer and between the elastic layer and the compressed layer, various adhesives or doubled-sided adhesive tapes can also be used in order to fix them to each other. The transfer member **2** may also include a reinforce layer high in compressive modulus in order to suppress elongation in a horizontal direction or maintain resilience when attached to the transfer drum **41**. Woven fabric may be used as a reinforce layer. The transfer member **2** can be manufactured by combining the respective layers formed by the materials described above in any desired manner.

The outer peripheral surface of the pressurizing drum **42** is pressed against the transfer member **2**. At least one grip mechanism which grips the leading edge portion of the print medium P is provided on the outer peripheral surface of the pressurizing drum **42**. A plurality of grip mechanisms may be provided separately in the circumferential direction of the pressurizing drum **42**. The ink image on the transfer member **2** is transferred to the print medium P when it passes through a nip portion between the pressurizing drum **42** and the transfer member **2** while being conveyed in tight contact with the outer peripheral surface of the pressurizing drum **42**.

The transfer drum **41** and the pressurizing drum **42** share a driving source such as a motor that drives them. A driving force can be delivered by a transmission mechanism such as a gear mechanism.

<Peripheral Unit>

The peripheral units **5**A to **5**D are arranged around the transfer drum **41**. In this embodiment, the peripheral units **5**A to **5**D are specifically an application unit, an absorption unit, a heating unit, and a cleaning unit in order.

The application unit **5**A is a mechanism which applies the reactive liquid onto the transfer member **2** before the print unit **3** discharges ink. The reactive liquid is a liquid that contains a component increasing an ink viscosity. An increase in ink viscosity here means that a coloring material, a resin, and the like that form the ink react chemically or suck physically by contacting the component that increases the ink viscosity, recognizing the increase in ink viscosity. This increase in ink viscosity includes not only a case in which an increase in viscosity of entire ink is recognized but also a case in which a local increase in viscosity is generated by coagulating some of components such as the coloring material and the resin that form the ink.

The component that increases the ink viscosity can use, without particular limitation, a substance such as metal ions or a polymeric coagulant that causes a pH change in ink and coagulates the coloring material in the ink, and can use an organic acid. For example, a roller, a printhead, a die coating apparatus (die coater), a blade coating apparatus (blade coater), or the like can be given as a mechanism which applies the reactive liquid. If the reactive liquid is applied to the transfer member **2** before the ink is discharged to the transfer member **2**, it is possible to immediately fix ink that reaches the transfer member **2**. This makes it possible to suppress bleeding caused by mixing adjacent inks.

The absorption unit **5**B is a mechanism which absorbs a liquid component from the ink image on the transfer member **2** before transfer. It is possible to suppress, for example, a blur of an image printed on the print medium P by decreasing the liquid component of the ink image. Describing a decrease in liquid component from another point of view, it is also possible to represent it as condensing ink that forms the ink image on the transfer member **2**. Condensing the ink means increasing the content of a solid content such as a coloring material or a resin included in the ink with respect to the liquid component by decreasing the liquid component included in the ink.

The absorption unit **5**B includes, for example, a liquid absorbing member that decreases the amount of the liquid component of the ink image by contacting the ink image. The liquid absorbing member may be formed on the outer peripheral surface of the roller or may be formed into an endless sheet-like shape and run cyclically. In terms of protection of the ink image, the liquid absorbing member may be moved in synchronism with the transfer member **2** by making the moving speed of the liquid absorbing member equal to the peripheral speed of the transfer member **2**.

The liquid absorbing member may include a porous body that contacts the ink image. The pore size of the porous body on the surface that contacts the ink image may be equal to or smaller than 10 μm in order to suppress adherence of an ink solid content to the liquid absorbing member. The pore size here refers to an average diameter and can be measured by a known means such as a mercury intrusion technique, a

nitrogen adsorption method, an SEM image observation, or the like. Note that the liquid component does not have a fixed shape, and is not particularly limited if it has fluidity and an almost constant volume. For example, water, an organic solvent, or the like contained in the ink or reactive liquid can be given as the liquid component.

The heating unit **5**C is a mechanism which heats the ink image on the transfer member **2** before transfer. A resin in the ink image melts by heating the ink image, improving transferability to the print medium P. A heating temperature can be equal to or higher than the minimum film forming temperature (MFT) of the resin. The MFT can be measured by each apparatus that complies with a generally known method such as JIS K 6828-2: 2003 or ISO 2115: 1996. From the viewpoint of transferability and image robustness, the ink image may be heated at a temperature higher than the MFT by 10° C. or higher, or may further be heated at a temperature higher than the MFT by 20° C. or higher. The heating unit **5**C can use a known heating device, for example, various lamps such as infrared rays, a warm air fan, or the like. An infrared heater can be used in terms of heating efficiency.

The cleaning unit **5**D is a mechanism which cleans the transfer member **2** after transfer. The cleaning unit **5**D removes ink remaining on the transfer member **2**, dust on the transfer member **2**, or the like. The cleaning unit **5**D can use a known method, for example, a method of bringing a porous member into contact with the transfer member **2**, a method of scraping the surface of the transfer member **2** with a brush, a method of scratching the surface of the transfer member **2** with a blade, or the like as needed. A known shape such as a roller shape or a web shape can be used for a cleaning member used for cleaning.

As described above, in this embodiment, the application unit **5**A, the absorption unit **5**B, the heating unit **5**C, and the cleaning unit **5**D are included as the peripheral units. However, cooling functions of the transfer member **2** may be applied, or cooling units may be added to these units. In this embodiment, the temperature of the transfer member **2** may be increased by heat of the heating unit **5**C. If the ink image exceeds the boiling point of water as a prime solvent of ink after the print unit **3** discharges ink to the transfer member **2**, performance of liquid component absorption by the absorption unit **5**B may be degraded. It is possible to maintain the performance of liquid component absorption by cooling the transfer member **2** such that the temperature of the discharged ink is maintained below the boiling point of water.

The cooling unit may be an air blowing mechanism which blows air to the transfer member **2**, or a mechanism which brings a member (for example, a roller) into contact with the transfer member **2** and cools this member by air-cooling or water-cooling. The cooling unit may be a mechanism which cools the cleaning member of the cleaning unit **5**D. A cooling timing may be a period before application of the reactive liquid after transfer.

<Supply Unit>

The supply unit **6** is a mechanism which supplies ink to each printhead **30** of the print unit **3**. The supply unit **6** may be provided on the rear side of the printing system **1**. The supply unit **6** includes a reservoir TK that reserves ink for each kind of ink. Each reservoir TK may be made of a main tank and a sub tank. Each reservoir TK and a corresponding one of the printheads **30** communicate with each other by a liquid passageway **6***a*, and ink is supplied from the reservoir TK to the printhead **30**. The liquid passageway **6***a* may circulate ink between the reservoirs TK and the printheads **30**. The supply unit **6** may include, for example, a pump that circulates ink. A deaerating mechanism which deaerates bubbles in ink may be provided in the middle of the liquid passageway **6***a* or in each reservoir TK. A valve that adjusts the fluid pressure of ink and an atmospheric pressure may be provided in the middle of the liquid passageway **6***a* or in each reservoir TK. The heights of each reservoir TK and each printhead **30** in the Z direction may be designed such that the liquid surface of ink in the reservoir TK is positioned lower than the ink discharge surface of the printhead **30**.

<Conveyance Apparatus>

The conveyance apparatus **1**B is an apparatus that feeds the print medium P to the transfer unit **4** and discharges, from the transfer unit **4**, the printed product P' to which the ink image was transferred. The conveyance apparatus **1**B includes a feeding unit **7**, a plurality of conveyance drums **8** and **8***a*, two sprockets **8***b*, a chain **8***c*, and a collection unit **8***d*. In FIG. **1**, an arrow inside a view of each constituent element in the conveyance apparatus **1**B indicates a rotation direction of the constituent element, and an arrow outside the view of each constituent element indicates a conveyance path of the print medium P or the printed product P'. The print medium P is conveyed from the feeding unit **7** to the transfer unit **4**, and the printed product P' is conveyed from the transfer unit **4** to the collection unit **8***d*. The side of the feeding unit **7** may be referred to as an upstream side in a conveyance direction, and the side of the collection unit **8***d* may be referred to as a downstream side.

The feeding unit **7** includes a stacking unit where the plurality of print media P are stacked and a feeding mechanism which feeds the print media P one by one from the stacking unit to the most upstream conveyance drum **8**. Each of the conveyance drums **8** and **8***a* is a rotating body that rotates about the rotation axis in the Y direction and has a columnar outer peripheral surface. At least one grip mechanism which grips the leading edge portion of the print medium P (printed product P') is provided on the outer peripheral surface of each of the conveyance drums **8** and **8***a*. A gripping operation and release operation of each grip mechanism may be controlled such that the print medium P is transferred between the adjacent conveyance drums.

The two conveyance drums **8***a* are used to reverse the print medium P. When the print medium P undergoes double-side printing, it is not transferred to the conveyance drum **8** adjacent on the downstream side but transferred to the conveyance drums **8***a* from the pressurizing drum **42** after transfer onto the surface. The print medium P is reversed via the two conveyance drums **8***a* and transferred to the pressurizing drum **42** again via the conveyance drums **8** on the upstream side of the pressurizing drum **42**. Consequently, the reverse surface of the print medium P faces the transfer drum **41**, transferring the ink image to the reverse surface.

The chain **8***c* is wound between the two sprockets **8***b*. One of the two sprockets **8***b* is a driving sprocket, and the other is a driven sprocket. The chain **8***c* runs cyclically by rotating the driving sprocket. The chain **8***c* includes a plurality of grip mechanisms spaced apart from each other in its longitudinal direction. Each grip mechanism grips the end of the printed product P'. The printed product P' is transferred from the conveyance drum **8** positioned at a downstream end to each grip mechanism of the chain **8***c*, and the printed product P' gripped by the grip mechanism is conveyed to the collection unit **8***d* by running the chain **8***c*, releasing gripping. Consequently, the printed product P' is stacked in the collection unit **8***d*.

<Post Processing Unit>

The conveyance apparatus **1**B includes post processing units **10**A and **10**B. The post processing units **10**A and **10**B are mechanisms which are arranged on the downstream side of the transfer unit **4**, and perform post processing on the printed product P'. The post processing unit **10**A performs processing on the obverse surface of the printed product P', and the post processing unit **10**B performs processing on the reverse surface of the printed product P'. The contents of the post processing includes, for example, coating that aims at protection, glossy, and the like of an image on the image printed surface of the printed product P'. For example, liquid application, sheet welding, lamination, and the like can be given as an example of coating.

<Inspection Unit>

The conveyance apparatus **1**B includes inspection units **9**A and **9**B. The inspection units **9**A and **9**B are mechanisms which are arranged on the downstream side of the transfer unit **4**, and inspect the printed product P'.

In this embodiment, the inspection unit **9**A is an image capturing apparatus that captures an image printed on the printed product P' and includes an image sensor, for example, a CCD sensor, a CMOS sensor, or the like. The inspection unit **9**A captures a printed image while a printing operation is performed continuously. Based on the image captured by the inspection unit **9**A, it is possible to confirm a temporal change in tint or the like of the printed image and determine whether to correct image data or print data. In this embodiment, the inspection unit **9**A has an imaging range set on the outer peripheral surface of the pressurizing drum **42** and is arranged to be able to partially capture the printed image immediately after transfer. The inspection unit **9**A may inspect all printed images or may inspect the images every predetermined sheets.

In this embodiment, the inspection unit **9**B is also an image capturing apparatus that captures an image printed on the printed product P' and includes an image sensor, for example, a CCD sensor, a CMOS sensor, or the like. The inspection unit **9**B captures a printed image in a test printing operation. The inspection unit **9**B can capture the entire printed image. Based on the image captured by the inspection unit **9**B, it is possible to perform basic settings for various correction operations regarding print data. In this embodiment, the inspection unit **9**B is arranged at a position to capture the printed product P' conveyed by the chain **8***c*. When the inspection unit **9**B captures the printed image, it captures the entire image by temporarily suspending the run of the chain **8***c*. The inspection unit **9**B may be a scanner that scans the printed product P'.

<Control Unit>

A control unit of the printing system **1** will be described next. FIGS. **4** and **5** are block diagrams each showing a control unit **13** of the printing system **1**. The control unit **13** is communicably connected to a higher level apparatus (DFE) HC**2**, and the higher level apparatus HC**2** is communicably connected to a host apparatus HC**1**.

The host apparatus HC**1** may be, for example, a PC (Personal Computer) serving as an information processing apparatus, or a server apparatus. A communication method between the host apparatus HC**1** and the higher level apparatus HC**2** may be, without particular limitation, either wired or wireless communication.

Original data to be the source of a printed image is generated or saved in the host apparatus HC**1**. The original data here is generated in the format of, for example, an electronic file such as a document file or an image file. This original data is transmitted to the higher level apparatus HC**2**. In the higher level apparatus HC**2**, the received original data is converted into a data format (for example, RGB data that represents an image by RGB) available by the control unit **13**. The converted data is transmitted from the higher level apparatus HC**2** to the control unit **13** as image data. The control unit **13** starts a printing operation based on the received image data.

In this embodiment, the control unit **13** is roughly divided into a main controller **13**A and an engine controller **13**B. The main controller **13**A includes a processing unit **131**, a storage unit **132**, an operation unit **133**, an image processing unit **134**, a communication I/F (interface) **135**, a buffer **136**, and a communication I/F **137**.

The processing unit **131** is a processor such as a CPU, executes programs stored in the storage unit **132**, and controls the entire main controller **13**A. The storage unit **132** is a storage device such as a RAM, a ROM, a hard disk, or an SSD, stores data and the programs executed by the processing unit (CPU) **131**, and provides the processing unit (CPU) **131** with a work area. An external storage unit may further be provided in addition to the storage unit **132**. The operation unit **133** is, for example, an input device such as a touch panel, a keyboard, or a mouse and accepts a user instruction. The operation unit **133** may be formed by an input unit and a display unit integrated with each other. Note that a user operation is not limited to an input via the operation unit **133**, and an arrangement may be possible in which, for example, an instruction is accepted from the host apparatus HC**1** or the higher level apparatus HC**2**.

The image processing unit **134** is, for example, an electronic circuit including an image processing processor. The buffer **136** is, for example, a RAM, a hard disk, or an SSD. The communication I/F **135** communicates with the higher level apparatus HC**2**, and the communication I/F **137** communicates with the engine controller **13**B. In FIG. **4**, broken-line arrows exemplify the processing sequence of image data. Image data received from the higher level apparatus HC**2** via the communication I/F **135** is accumulated in the buffer **136**. The image processing unit **134** reads out the image data from the buffer **136**, performs predetermined image processing on the readout image data, and stores the processed data in the buffer **136** again. The image data after the image processing stored in the buffer **136** is transmitted from the communication I/F **137** to the engine controller **13**B as print data used by a print engine.

As shown in FIG. **5**, the engine controller **13**B includes an engine control units **14** and **15**A to **15**E, and obtains a detection result of a sensor group/actuator group **16** of the printing system **1** and controls driving of the groups. Each of these control units includes a processor such as a CPU, a storage device such as a RAM or a ROM, and an interface with an external device. Note that the division of the control units is merely illustrative, and a plurality of subdivided control units may perform some of control operations or conversely, the plurality of control units may be integrated with each other, and one control unit may be configured to implement their control contents.

The engine control unit **14** controls the entire engine controller **13**B. The printing control unit **15**A converts print data received from the main controller **13**A into raster data or the like in a data format suitable for driving of the printheads **30**. The printing control unit **15**A controls discharge of each printhead **30**.

The transfer control unit **15**B controls the application unit **5**A, the absorption unit **5**B, the heating unit **5**C, and the cleaning unit **5**D.

The reliability control unit **15**C controls the supply unit **6**, the recovery unit **12**, and a driving mechanism which moves the print unit **3** between the discharge position POS**1** and the recovery position POS**3**.

The conveyance control unit **15**D controls driving of the transfer unit **4** and controls the conveyance apparatus **1**B. The inspection control unit **15**E controls the inspection unit **9**B and the inspection unit **9**A.

Of the sensor group/actuator group **16**, the sensor group includes a sensor that detects the position and speed of a movable part, a sensor that detects a temperature, an image sensor, and the like. The actuator group includes a motor, an electromagnetic solenoid, an electromagnetic valve, and the like.

<Operation Example>

FIG. **6** is a view schematically showing an example of a printing operation. Respective steps below are performed cyclically while rotating the transfer drum **41** and the pressurizing drum **42**. As shown in a state ST**1**, first, a reactive liquid L is applied from the application unit **5**A onto the transfer member **2**. A portion to which the reactive liquid L on the transfer member **2** is applied moves along with the rotation of the transfer drum **41**. When the portion to which the reactive liquid L is applied reaches under the printhead **30**, ink is discharged from the printhead **30** to the transfer member **2** as shown in a state ST**2**. Consequently, an ink image IM is formed. At this time, the discharged ink mixes with the reactive liquid L on the transfer member **2**, promoting coagulation of the coloring materials. The discharged ink is supplied from the reservoir TK of the supply unit **6** to the printhead **30**.

The ink image IM on the transfer member **2** moves along with the rotation of the transfer member **2**. When the ink image IM reaches the absorption unit **5**B, as shown in a state ST**3**, the absorption unit **5**B absorbs a liquid component from the ink image IM. When the ink image IM reaches the heating unit **5**C, as shown in a state ST**4**, the heating unit **5**C heats the ink image IM, a resin in the ink image IM melts, and a film of the ink image IM is formed. In synchronism with such formation of the ink image IM, the conveyance apparatus **1**B conveys the print medium P.

As shown in a state ST**5**, the ink image IM and the print medium P reach the nip portion between the transfer member **2** and the pressurizing drum **42**, the ink image IM is transferred to the print medium P, and the printed product P' is formed. Passing through the nip portion, the inspection unit **9**A captures an image printed on the printed product P' and inspects the printed image. The conveyance apparatus **1**B conveys the printed product P' to the collection unit **8***d*.

When a portion where the ink image IM on the transfer member **2** is formed reaches the cleaning unit **5**D, it is cleaned by the cleaning unit **5**D as shown in a state ST**6**. After the cleaning, the transfer member **2** rotates once, and transfer of the ink image to the print medium P is performed repeatedly in the same procedure. The description above has been given such that transfer of the ink image IM to one print medium P is performed once in one rotation of the transfer member **2** for the sake of easy understanding. It is possible, however, to continuously perform transfer of the ink image IM to the plurality of print media P in one rotation of the transfer member **2**.

Each printhead **30** needs maintenance if such a printing operation continues.

FIG. **7** shows an operation example at the time of maintenance of each printhead **30**. A state ST**11** shows a state in which the print unit **3** is positioned at the discharge position POS**1**. A state ST**12** shows a state in which the print unit **3** passes through the preliminary recovery position POS**2**. Under passage, the recovery unit **12** performs a process of recovering discharge performance of each printhead **30** of the print unit **3**. Subsequently, as shown in a state ST**13**, the recovery unit **12** performs the process of recovering the discharge performance of each printhead **30** in a state in which the print unit **3** is positioned at the recovery position POS**3**.

Suction recovery performed by the recovery unit **12** on the printheads **30** at the recovery position POS in the printing system having the above arrangement will be described next. Note that a transfer member may also be referred to as an ink receiving member in a sense that ink is discharged to the transfer member.

<Detailed Description of Suction Recovery Operation>

FIG. **8** is a perspective view showing the arrangement of printheads. In FIG. **8**, the X-, Y-, and Z-axes indicate the same directions as shown in FIGS. **1** to **3** and **7**. Note that the X-axis, the Y-axis, and the Z-axis are perpendicular to each other. A relationship in which two printheads **30**A and **30**B are arranged is illustrated here for the sake of descriptive simplicity.

The two printheads **30**A and **30**B have print widths of the same length in a Y-axis direction, and printing elements equal in number are arrayed at the same pitch in the Y-axis direction. Therefore, the two printheads have the same printing resolution in the Y-axis direction. In addition, as shown in FIG. **8**, the two ends of each of the two printheads are arranged to be at the same position in the Y-axis direction.

FIG. **9** is a perspective view showing the arrangement of suction wipers of the recovery unit **12**. Also in FIG. **9**, the X-, Y-, and Z-axes indicate the same directions as shown in FIGS. **1** to **3**, **7**, and **8**. A relationship in which two suction wipers **120**A and **120**B are arranged in correspondence with the two printheads **30**A and **30**B, respectively, shown in FIG. **8** is illustrated here for the sake of descriptive simplicity.

As shown in FIG. **9**, however, reference symbols Y_2 and Y_1, respectively, denote positions of the suction wiper **120**A corresponding to the printhead **30**A and the suction wiper **120**B corresponding to the printhead **30**B in the Y-axis direction. Then, these two positions are separated from each other by a distance L to provide the two suction wipers. The two suction wipers **120**A and **120**B are, respectively, fixed to corresponding holders **121**A and **121**B. When the suction recovery operation (suction operation) is started, these two holders are moved concurrently from one end to the other end of each of the printheads **30**A and **30**B in the Y-axis direction by the same driving source (driving motor), and perform suction recovery of these two printheads. As described above with reference to FIG. **7**, the suction recovery operation is performed in a state in which the print unit **3** is positioned at the recovery position POS**3**.

More specifically, when the two suction wipers are at one end of each of the two printheads, the two holders rise in a Z-axis direction, and bring suction ports of the two suction wipers into contact with the ink discharge surfaces of the corresponding two printheads, respectively. Subsequently, a suction pump (not shown) is driven to generate a negative-pressure in each suction port, and perform suction recovery while moving the two holders **121**A and **121**B in the Y-axis direction. Note that with this suction recovery operation, sucked waste ink is discharged via tubes **122**A and **122**B which are, respectively, provided for the two holders **121**A and **121**B. In this embodiment, one suction pump is pro-

vided as a common negative-pressure generation source to the two suction wipers and is configured to generate a suction force.

FIGS. **10**A and **10**B are views each showing a state in which the two suction wipers perform the suction recovery operation while moving on the ink discharge surfaces of the two printheads. Also in FIGS. **10**A and **10**B, the X-, Y-, and Z-axes indicate the same directions as shown in FIGS. **1** to **3** and **7** to **9**.

FIG. **10**A shows the arrangement of the related art in which the two suction wipers are provided at the same position in the Y-axis direction and suck the same position of the two printheads at the same timing for the sake of comparison, and FIG. **10**B shows an example of the arrangement according to this embodiment. Note that each printhead shown in FIGS. **10**A and **10**B uses a full-line printhead having a print width increased in length by connecting and arranging the plurality of head substrates **100** of the same size each having a parallelogrammic shape in the Y-axis direction. However, the shape of a head substrate need not always be the parallelogram, and a plurality of rectangular head substrates may be arranged in the Y-axis direction. Alternatively, an arrangement in which a plurality of head substrates each having a trapezoidal shape are arranged in the Y-axis direction while positioning their upper sides and lower sides alternately may be adopted.

In either case, in a case where the plurality of head substrates are arranged in the Y-axis direction, the concave gaps **130** with respect to the ink discharge surfaces are formed between the head substrates as also described in a conventional technique.

Therefore, in the conventional arrangement as shown in FIG. **10**A, when the two suction wipers **120**A and **120**B move in the Y-axis direction in order to perform suction recovery, they pass through the gap **130** of the printhead **30**A and the gap **130** of the printhead **30**B at the same timing. As described above, because the gaps **130** are concave, external air flows into the suction ports of the two suction wipers at that pass timing, resulting in a suction pressure by the suction pump dropping.

To cope with this, according to the arrangement as shown in FIG. **10**B according to this embodiment, the two suction wipers **120**A and **120**B are provided while being separated from each other in the Y-axis direction. Consequently, when the two suction wipers **120**A and **120**B move in the Y-axis direction, pass timings at which these two suction wipers pass through the gap **130** of the printhead **30**A and the gap **130** of the printhead **30**B are different from each other. In the suction recovery operation, both the suction wipers pass through the gaps **130**, but the number of suction wipers passing through the gaps **130** is one at maximum at any timing. Accordingly, a drop in suction pressure by the suction pump caused by the external air flowing into the suction ports of the suction wipers when the suction wipers pass through the gaps becomes smaller than in the arrangement of the related art.

Therefore, according to the above-described embodiment, it is possible to suppress the drop in suction pressure by the suction pump caused when the suction wipers pass through the gaps between the head substrates to the minimum in the suction recovery operation. This makes it possible to ensure a sufficient suction force of the suction pump, perform a sufficient suction operation, and hold each printhead in a satisfactory state.

Note that the example in which suction recovery is performed on the two printheads by using the two suction wipers has been described above for the sake of descriptive simplicity. However, the present invention is not limited to this. For example, suction recovery may be performed on three printheads by using three suction wipers or on four printheads by using four suction wipers as long as an arrangement for using the common suction pump as the negative-pressure generation source is adopted. In this case, an arrangement in which a common negative-pressure generation source is used for each set made from a plurality of printheads, and the positions of the suction wipers are different in the respective sets can be adopted.

Moreover, a separation interval in a case where the two suction wipers are arranged is determined by the size of each of the plurality of head substrates used for the printheads, for example, the degree of the tilt of each hypotenuse in the case of a parallelogrammic substrate, and the present invention is not limited to the above-described example. In other words, in a case where the plurality of wipers are moved in a nozzle arrayed direction of each printhead, the separation interval of these wipers can be determined such that the number of wipers passing through the gaps on the head substrates is one at maximum at any timing.

Furthermore, the example in which the two suction wipers which are driven concurrently by the same driving source but different in position provided in the Y-axis direction are used has been described in the above-described embodiment. However, the present invention is not limited to this. For example, a driving mechanism for providing two holders that fix two suction wipers at the same position in the Y-axis direction, and driving and moving them independently of each other may be provided. In this case, the two holders have different moving start timings, making it possible to control the two suction wipers to pass through the gap **130** of the printhead **30**A and the gap **130** of the printhead **30**B at different timings.

In the above embodiment, the print unit **3** includes the plurality of printheads **30**. However, a print unit **3** may include one printhead **30**. The printhead **30** may not be a full-line head, but may be of a serial type that forms an ink image while scanning a carriage to which the printhead **30** is detachably mounted in a Y direction, and discharging ink from the printhead **30**.

A conveyance mechanism of the print medium P may adopt another method such as a method of clipping and conveying the print medium P by the pair of rollers. In the method of conveying the print medium P by the pair of rollers or the like, a roll sheet may be used as the print medium P, and a printed product P' may be formed by cutting the roll sheet after transfer.

In the above embodiment, the transfer member **2** is provided on the outer peripheral surface of the transfer drum **41**. However, another method such as a method of forming a transfer member **2** into an endless swath and running it cyclically may be used.

Embodiment(s) of the present invention can also be realized by a computer of a system or apparatus that reads out and executes computer executable instructions (e.g., one or more programs) recorded on a storage medium (which may also be referred to more fully as a 'non-transitory computer-readable storage medium') to perform the functions of one or more of the above-described embodiment(s) and/or that includes one or more circuits (e.g., application specific integrated circuit (ASIC)) for performing the functions of one or more of the above-described embodiment(s), and by a method performed by the computer of the system or apparatus by, for example, reading out and executing the computer executable instructions from the storage medium to perform the functions of one or more of the above-

described embodiment(s) and/or controlling the one or more circuits to perform the functions of one or more of the above-described embodiment(s). The computer may comprise one or more processors (e.g., central processing unit (CPU), micro processing unit (MPU)) and may include a network of separate computers or separate processors to read out and execute the computer executable instructions. The computer executable instructions may be provided to the computer, for example, from a network or the storage medium. The storage medium may include, for example, one or more of a hard disk, a random-access memory (RAM), a read only memory (ROM), a storage of distributed computing systems, an optical disk (such as a compact disc (CD), digital versatile disc (DVD), or Blu-ray Disc (BD)™), a flash memory device, a memory card, and the like.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2017-047489, filed Mar. 13, 2017, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A printing apparatus comprising:

a first printhead in which a plurality of first head substrates are arranged in a first direction and there are gaps between neighboring first head substrates, each first head substrate having a plurality of first nozzles arrayed in the first direction, each first nozzle discharging first ink;

a second printhead in which a plurality of second head substrates are arranged in the first direction and there are gaps between neighboring second head substrates, each second head substrate having a plurality of second nozzles arrayed in the first direction, each second nozzle discharging second ink, wherein the first printhead and the second printhead are arranged in a second direction intersecting with the first direction;

a first suction unit configured to suck the first ink from the plurality of first nozzles of the first printhead by moving in the first direction while being in contact with the plurality of first head substrates;

a second suction unit configured to suck the second ink from the plurality of second nozzles of the second printhead by moving in the first direction while being in contact with the plurality of second head substrates;

a common negative-pressure generation unit configured to generate a negative-pressure in the first suction unit and the second suction unit; and

a moving unit configured to move the first suction unit and the second suction unit in the first direction,

wherein the moving unit moves the first suction unit and the second suction unit such that times at which the first suction unit passes the gaps between the neighboring first head substrates are different from those at which the second suction unit passes the gaps between the neighboring second head substrates.

2. The apparatus according to claim **1**, wherein in a case where the moving unit concurrently moves the first suction unit and the second suction unit by a common driving source, the first suction unit and the second suction unit are provided while being separated from each other in the first direction.

3. The apparatus according to claim **2**, wherein a suction port of the first suction unit and a suction port of the second suction unit are provided at different positions in the first direction.

4. The apparatus according to claim **1**, wherein in a case where the first suction unit and the second suction unit are provided at the same position concerning the first direction, the moving unit moves the first suction unit and the second suction unit at moving start timings independent of each other.

5. The apparatus according to claim **1**, wherein each of the plurality of head substrates has a parallelogrammic shape.

6. The apparatus according to claim **1**, wherein the first suction unit includes:

a first suction wiper contacting the ink discharge surface of the first printhead and configured to suck the plurality of nozzles of the first printhead;

a first holder configured to fix the first suction wiper; and

a first tube connected to the first suction wiper and configured to discharge waste ink sucked via the first suction wiper, and

the second suction unit includes:

a second suction wiper contacting the ink discharge surface of the second printhead and configured to suck the plurality of nozzles of the second printhead;

a second holder configured to fix the second suction wiper; and

a second tube connected to the second suction wiper and configured to discharge waste ink sucked via the second suction wiper.

7. The apparatus according to claim **6**, wherein the common negative-pressure generation unit includes a suction pump configured to generate a negative-pressure in each of a suction port of the first suction wiper and a suction port of the second suction wiper.

8. The apparatus according to claim **7**, wherein when the moving unit causes the first suction wiper to pass through the gaps between the neighboring first head substrates of the first printhead and the second suction wiper to pass through the gaps between the neighboring second head substrates of the second printhead, air flows in from the suction port of the first suction wiper and the suction port of the second suction wiper.

9. The apparatus according to claim **1**, wherein each of the first printhead and the second printhead is a full-line printhead.

10. The apparatus according to claim **1**, wherein a suction operation by the first suction unit and the second suction unit is performed at a second position, at which the first printhead and the second printhead do not face the ink receiving member, retracted from a first position where the first printhead and the second printhead are positioned facing the ink receiving member, and print the image by discharging the ink to the ink receiving member, and

the suction operation by the first suction unit and the second unit is not performed at the first position.

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